

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

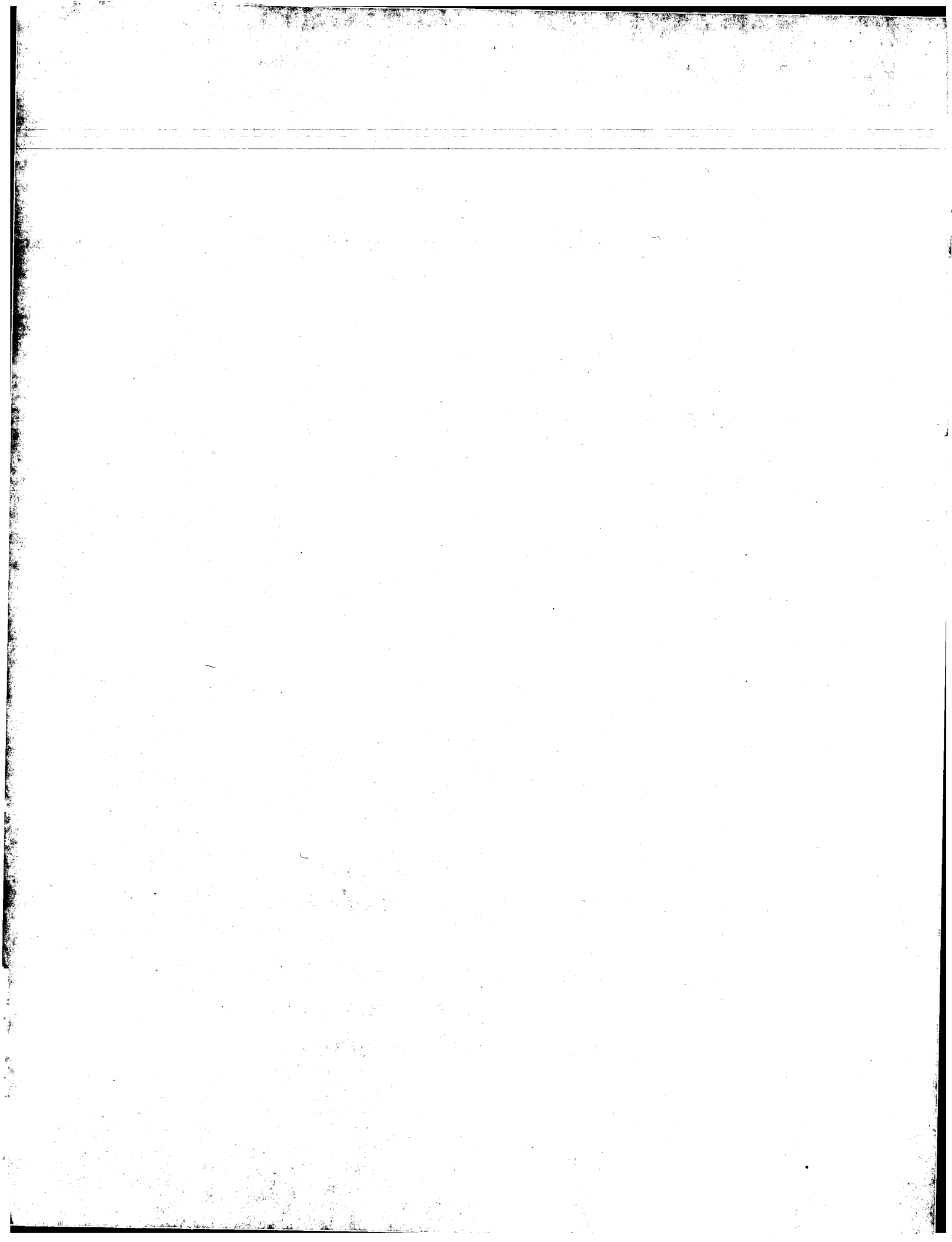
Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problem Mailbox.**





PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : 10/606,113 Confirmation No. : 3703
Applicant : JAMES JOSEPH FISHER, et al.
Filed : June 26, 2003
TC/A.U. : 2821
Examiner : N/A
Docket No. : 038819.52556US
Customer No. : 23911
Title : AN ANTENNA

CLAIM FOR PRIORITY UNDER 35 U.S.C. §119

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

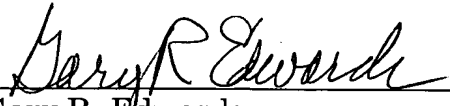
February 5, 2004

Sir:

The benefit of the filing date of prior foreign application No. 0216938.1 filed in Great Britain on July 20, 2002, is hereby requested and the right of priority under 35 U.S.C. §119 is hereby claimed.

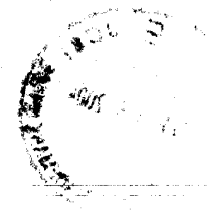
In support of this claim, filed herewith is a certified copy of the original foreign application.

Respectfully submitted,



Gary R. Edwards
Registration No. 31,824

CROWELL & MORING LLP
Intellectual Property Group
P.O. Box 14300
Washington, DC 20044-4300
Telephone: 202-624-2500
Facsimile: 202-628-8844
GRE:kms
302266





INVESTOR IN PEOPLE

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated

11 June 2003



**Statement of inventorship and of
right to grant of a patent**

(See the notes on the back of this form)

The Patent Office

Cardiff Road
Newport
Gwent NP10 8QQ

1. Your reference

2002P09548 GB / R76 / MOM / GD

2. Patent application number
(If you know it)

0216938.1

20 JUL 2002

3. Full name of the or of each applicant

HONE MINOR RESEARCH LIMITED
Old Salisbury Lane, Romsey
Hampshire SO51 0ZN

4. Title of the invention

An Antenna

5. State how the applicant(s) derived the right
from the inventor(s) to be granted a patent

By provisions of contract of service and Section 39(1)
(a) and (b) of the Patent Act 1977.

6. How many, if any, additional Patents Forms
7/77 are attached to this form?
(see note (c))

1+2

7.

I/We believe that the person(s) named over the page
(and on any extra copies of this form) is/are the
inventor(s) of the invention which the above patent
application relates to.

Signature

Date

Marc Morgan

18.07.2002

Intellectual Property Department

8. Name and daytime telephone number of
person to contact in the United Kingdom

Marc Morgan

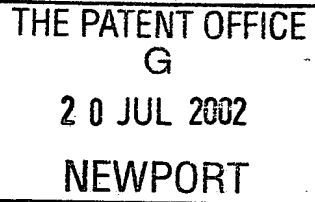
01794 833120

Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

	<p>1) <u>FISHER</u> James Joseph 29 Rances Way Badger Farm Winchester Hampshire GB</p> <p style="text-align: right;">8214207001</p> <p>Patents ADP number (if you know it):</p>
	<p>2) <u>STEVENS</u> Roderick Leonard Wallace 1 Ellen Gardens, Valley Park Chandlers Ford Eastleigh, Hampshire GB</p> <p style="text-align: right;">5967294001</p> <p>Patents ADP number (if you know it):</p>
	<p>3)</p> <p>Patents ADP number (if you know it):</p>
	<p>4)</p> <p>Patents ADP number (if you know it):</p>
	<p>5)</p> <p>Patents ADP number (if you know it):</p>
	<p>6)</p> <p>Patents ADP number (if you know it):</p>

Notes

- a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*
- b) *Write your answers in capital letters using black ink or you may type them.*
- c) *If there are more than three inventors, please give the names and addresses of the other inventors on the back of another Patents Form 7/77 and attach it to this form.*
- d) *When an application does not declare any priority, or declares priority from an earlier UK application, you must provide enough copies of this form so that the Patent Office can send one to each inventor who is not an applicant.*
- e) *Once you have filled in the form you must remember to sign and date it.*



The
Patent
Office

22JUL02 E734998-1 D00393
P01/7700 0.00-0216938.1

1/77

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
Gwent NP10 8QQ

1. Your reference

2002P09548 GB / R76 / MOM / GD

2. Patent application number
(The Patent Office will fill in this part)

20 JUL 2002

0216938.1

3. Full name, address and postcode of the or of each applicant (underline all surnames)

ROKE MANOR RESEARCH LIMITED
Old Salisbury Lane, Romsey
Hampshire SO51 OZN

5615455006

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

UNITED KINGDOM

4. Title of the invention

An Antenna

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Siemens Shared Services Limited
Intellectual Property Department
Siemens House
Oldbury
Bracknell
Berkshire RG12 8FZ

Patents ADP number (if you know it)

07764000001

7761000002

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filling of the or of each these earlier applications and (if you know it) the or each application number

Country Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filling date of the earlier application


8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:
a) any application named in part 3 is not an inventor, or
b) there is an inventor who is not named as an

Yes

applicant, or
c) any named applicant is a corporate body.
See note (d))

9. Enter the number of sheets for any of the following items you are filling with this form.
Do not count copies of the same document

Continuation sheets of this form

Description	7
Claim(s)	2
Abstract	1
Drawing(s)	5+5 

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translation of priority documents

Statement of inventorship and right to grant a patent (Patents Form 7/77)	1
---	---

Request for preliminary examination and search (Patents Form 9/77)	1
--	---

Request for substantive examination
(Patents Form 10/77)

Any other documents
(please specify)

11.

I/We request the grant of a patent on the basis of this application

Signature

Date

Marc Morgan
Intellectual Property Department

18.07.2002

12. Name and daytime telephone number of Person to contact in the United Kingdom

Marc Morgan

01794 833120

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting Written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or Communication has been given, or any such direction has been revoked.

Notes

- a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505
- b) Write your answers in capital letters using black ink or you may type them
- c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). any continuation sheet should be attached on this form.
- d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- e) Once you have filled in the form you must remember to sign and date it.
- f) For details of the fee and ways to pay please contact the Patent Office.

An Antenna

This invention relates to an antenna including Vivaldi antenna elements.

A Vivaldi antenna element is a radiating element having a tapering slot or notch
5 formed by the element which produces a linear polarisation to the radiated signal. An example of a Vivaldi antenna is described in patent application GB1601441.

Vivaldi type elements have been incorporated into larger arrays to form phased array antennas as described in EP0349069. The antenna produces radiated signals having planes of polarisation which are orthogonal and it is used in radar and other
10 direction finding applications. The array is formed by horizontal and vertically disposed planar substrates bearing the metallised layers etched to produce the antenna elements. The substrates are configured to interlock by means of inter-engaging projections and rebates and the array is formed into a number of square sectioned open ended boxes with the sides of the boxes each bearing a tapering Vivaldi notch. The problem of coupling
15 signals into and out of the notch when the two orthogonal notches have phase centres which are co-located is addressed in an imperfect manner in the prior art described in that document. Indeed the problem is described as insurmountable and another approach is adopted namely ensuring that phase centres of the elements are not co-located. However, by not co-locating the phase centres it is necessary for signal processing to be employed
20 that compensates for the arrival of an incoming signal at phase centres at different times and this is undesirable.

It is amongst the objects of the invention to mitigate or at least alleviate the drawbacks of the prior art arrangements.

According to the invention there is provided a dual polarised antenna comprising
5 at least first and second Vivaldi antenna elements, the first antenna element operating in a plane at an angle to the second, having their phase centres substantially co-located, and respective antenna element feeds coupled to respective antenna elements at a position displaced from an axis extending through the phase centres.

By locating the antenna element feeds at a position displaced from the axis it is
10 possible to arrange the antenna elements with their phase centres co-located.

Preferably the antenna elements are formed as metallised layers. Preferably, the antenna feed is connected to a land formed by the metallised layer. The metallised layer will extend inwards from the land towards the axis passing through the phase centre to a flare portion of the Vivaldi antenna.

15 A specific embodiment of the invention will now be described, by way of example only, with reference to the drawings in which:

Figure 1 shows antenna in accordance with the invention;

Figure 2 shows an antenna element used in the antenna of figure 1;

Figure 3 shows plan views of A and B type antenna elements used in the antenna
20 of figure 1;

Figure 4 shows an antenna element subassembly; and

Figure 5 shows antenna patterns of the antenna shown in figure 1.

As is shown in figure 1, an antenna in accordance with the invention 1 comprises a number of antenna elements four of which are shown although in practice there could
5 be many more. There are two types of elements, "A" elements 2,3 and "B" elements 4,5. (There is no significance to the choice of labels "A", "B".) These are physically interlocked by mutually engaging slots to form longitudinal antenna sub-units having a cruciform cross-section. The elements will be described in greater detail later.

The antenna sub-units are held between two Perspex mounting plates 6 and 7 in
10 conjunction with a number of Perspex corner spacers 8. The upper mounting plate 6 is provided with four co-axial cable connectors 9. The connectors 9 are coupled to the antenna elements 2 to 5 by means of four phase-matched semi-rigid cables 10. By phase-matched it means that the cables are of the same length to ensure that input signals reach the antenna elements at the same time. In use, the connectors are connected by co-axial
15 cable to a transmitter or receiver circuit of in this case a communications system.

All the elements, whether of type A or B, have planar metallised layers on a planar substrate. An element is shown in isolation in figure 2. It comprises three metallised and etched layers 21, 22 and 23 on a substrate of Rogers RT Duroid 6010 microwave substrate material 24. The thickness of the layers are exaggerated in the
20 figure for clarity. The two outer layer patterns are identical whilst the inner metal layer 22 departs from the shape of the outer layers as shown in broken outline. The inner layer is a reflection of the other layers in the axis 25 along the region 26. A slot 27 is provided

on the axis which as will be described later engages a slot formed in the other type of element.

Figure 2 also shows the manner in which the cables 10 are connected to the layers of the elements. It can be seen that an inner core 28 of the cable 10 is connected to the inner metallised layer 22 whilst the outer braid 29 is connected to both outer layers 21 and 23. The connections are made by soldering.

Having described the elements in a generic way a more detailed explanation of the elements will be given with reference to the plan views of figures 3a and 3b. Figure 3a shows the A type element. It comprises the three metallised layers etched to form the Vivaldi antenna on a substrate of Rogers RT Duroid 6010 material. In the figure the outermost metal layer 30 is shown in the darker shading. The other outermost layer on the lowest surface is not visible in the figure but it matches the shape of layer 30. The lighter shading shows the inner metal layer 31 which is hidden by the substrate.

The A element has a longitudinal phase centre axis 32 which passes through the locus of effective phase centre shown by arrow 33. The position of this will depend on the frequency in use. A slot 34 is provided along part of the length of the axis. This slot inter-engages with another formed on the other element during assembly.

The metallised layer 30 is configured into a number of distinct portions. Progressing from left to right in the figure the first portion is a stripline section 35. The stripline section 35 is formed as a generally rectangular pad to which the cable 10 is soldered. The inner side face of the rectangle curves outwards in the plane of the element and narrows to form a twinline section 36. The twinline section 36 curves gently

downwards towards the axis 32 and then curves back to the horizontal before the section broadens asymmetrically away from the axis to the edge of the element to form a feed flare 37. The outer edge 38 of the metallised layer remains over the rest of its axial length at the edge of the element. The inner edge 39 transitions from a downward curve of the feed flare to extend in an axial direction parallel to but spaced downwardly apart from the axis 32. This forms a constant slot section 40. At the end of the constant slot section 40 the inner edge curves smoothly away from the axis to a corner of the element to form an end flare 41. Overall the metallised layer 30 transitions from the stripline section 35 to the end flare 41 across the axis 32.

The other outer metallised layer (not shown) matches the described layer 30. The inner layer 31 matches the configuration of the stripline section 35 and most of the twinline section 36. However, in the transition from the twinline section to the feed flare the layer curves upwardly away from the axis as depicted in the figure. In a sense, the shape of the layer 31 over the feed, flare, constant slot section and the end flare is a mirror of the outer layer 30 with the notional mirror being at the axis 32. The performance of the layers is such as to give a locus of effective phase centre at the position indicated by arrow 33. The locus centre varies over the range of the arrow depending upon the frequency.

The other element type is shown in figure 3a. The metallised layers are of a similar configuration as earlier described. The main difference is that the twinline section 42 extends in an axial direction to form a part which is parallel 42a to the axis before it transitions to a downwardly curving portion 42b to meet the axis 32. It will be also noticed that the constant slot section of the first element type is not present in this type of

element with the feed flare 43 transitioning directly into the end flare 44. The layers have a performance which gives a locus of effective phase centre over a range represented by arrow 45 which extends along the axis. An axial slot 45 is provided to enable assembly to the other type of element to be described later.

5 The figures 3a and 3 are aligned to permit comparison of the features. It will be seen that A type of element has its locus of effective phase centre 33 over the same range of positions as the locus 45 of the type B element. The end flares of both types are of the same rate of curvature.

10 The elements are assembled by aligning the slots 45 and 33 and pushing the two elements axially together to engage the walls of each slot with the faces of the other element. This means of assembly is possible because of the off-axis connection facilitated by the stripline section 35. If the stripline were located on the axis the connections could not be made in the optimal manner. Figure 4 shows an assembled module of an A type element 47 and a B type element 48.

15 Figure 5 shows the measured beam pattern for the antenna. The top figure, figure 5a, shows the pattern of the A type element on its own and when used at the same time as the type B element is in use. The alone beam pattern 60 and the together beam pattern 61 are closely matched illustrating the antennas good performance.

20 Figure 5b shows the pattern for the B type element alone, line 62, and when used at the same time as the A type element, line 63. Again, the lines are closely matched illustrating the antennas good performance.

As will be appreciated a large number of variations in the antenna shape can be envisaged and many more elements of the same or different types can be combined into larger antenna arrays.

Claims

1. A dual polarised antenna comprising at least first and second Vivaldi antenna elements the first antenna element operating in a plane at an angle to the second
5 and having their phase centres substantially co-located, and respective antenna element feeds coupled to respective antenna elements at a position displaced from an axis extending through the phase centres.
2. An antenna as claimed in claim 1 wherein the antenna element includes an antenna feedline connected to the antenna element feeds at the position displaced from
10 the axis.
3. An antenna as claimed in claim 2 wherein the antenna feedline crosses the axis.
4. An antenna as claimed in claim 3 wherein the antenna feedline comprises as stripline section and a twinline section.
- 15 5. An antenna as claimed in any preceding claim wherein the element comprises a feed flare and an end flare.
6. An antenna as claimed in claim 5 wherein the element includes a substantially constant slot section disposed between the feed flare and the end flare.
7. An antenna as claimed in any preceding claim wherein the feedline
20 includes a parallel section substantially parallel to the axis.

8. An antenna as claimed in claim 7 wherein the parallel section of the first element has substantially the same length as the constant slot section of the other element.

9. An antenna as claimed in any preceding claim wherein the locus of effective phase centres of the elements are co-located.

10. An antenna as claimed in any preceding claim wherein the antenna elements are joined by mutually engaging formations.

11. An antenna as claimed in claim 10 wherein the mutually engaging formations include slots made in the elements.

12. An antenna as claimed in claim 11 wherein the elements are formed by substrates and metallised layers.

13. An antenna as claimed in any preceding claim wherein the first and the second elements have substantially matching end flares.

14. An antenna substantially as hereinbefore described with reference to, and as illustrated, by the drawings.

15. Radiowave receiving apparatus including an antenna as claimed in any preceding claim.

16. Radiowave transmitting apparatus including an antenna as claimed in any preceding claim.

Abstract

An Antenna

A dual polarised antenna 1 has two types of antenna elements combined. Each
5 type of antenna element is formed on a planar substrate. The substrates are furnished
with inter-engaging slots to enable assembly of the elements. Signal feeds are connected
to the active parts of the elements by means of connection points furnished at off axis
positions. The off-axis positions for connection enable an arrangement in which the
locus of the effective phase centres of the antenna element scan be co-located yielding a
10 convenient arrangement with good performance.

Figure 1

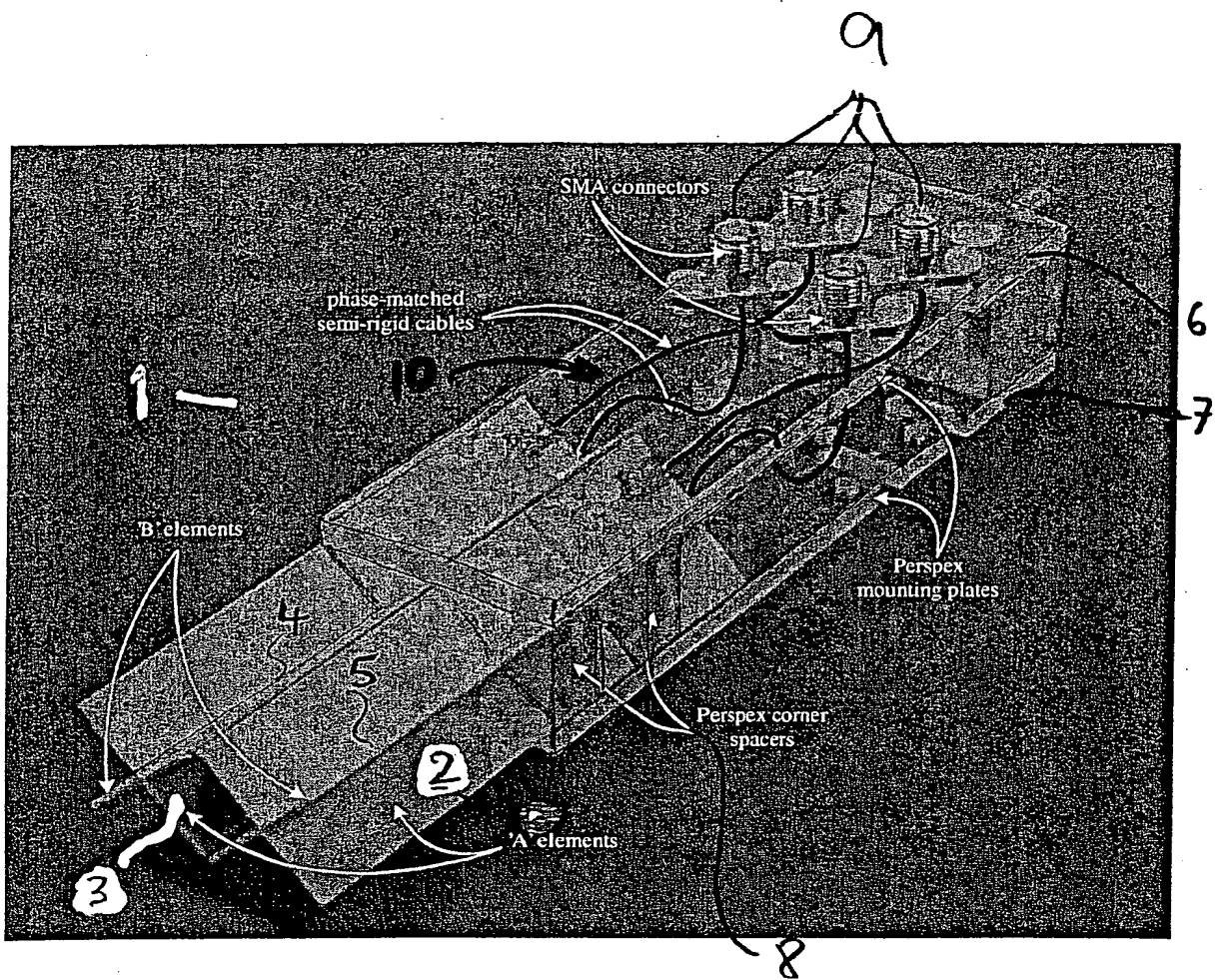
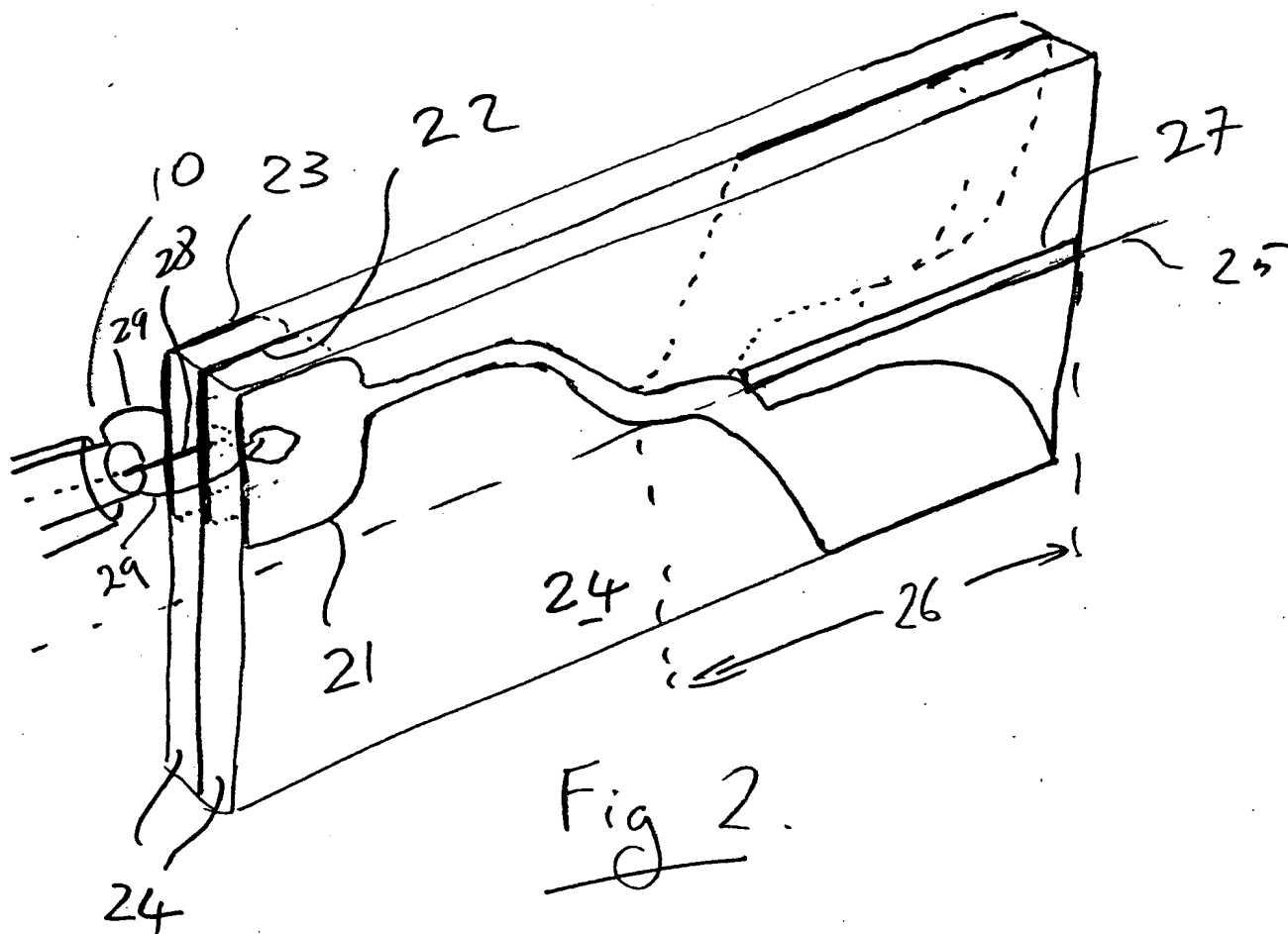
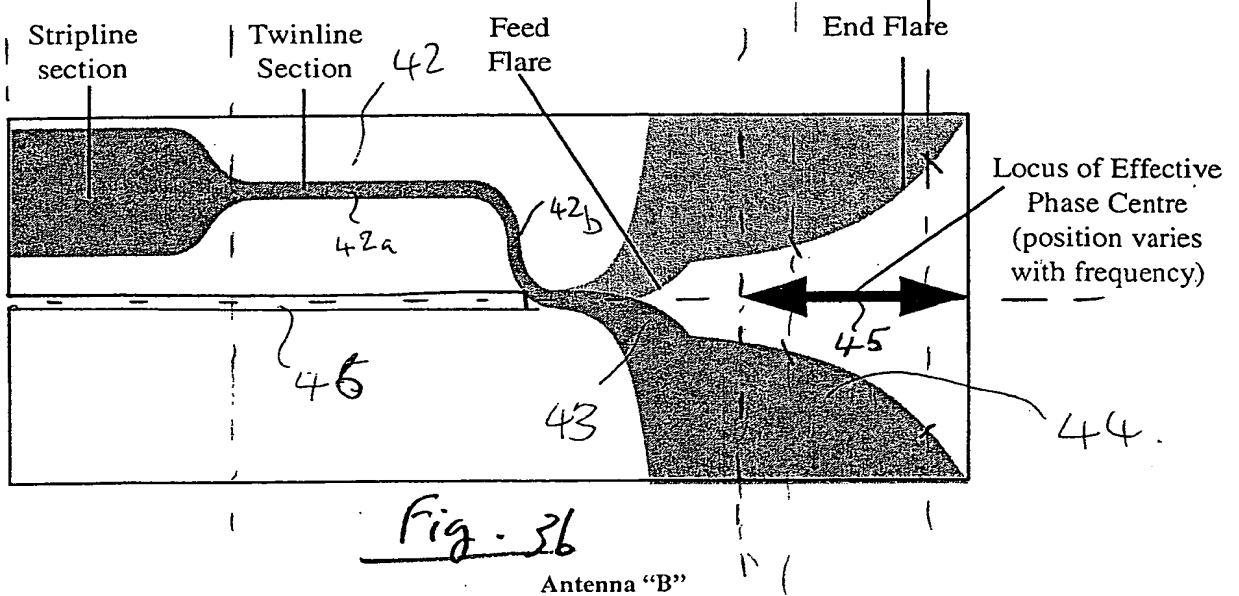
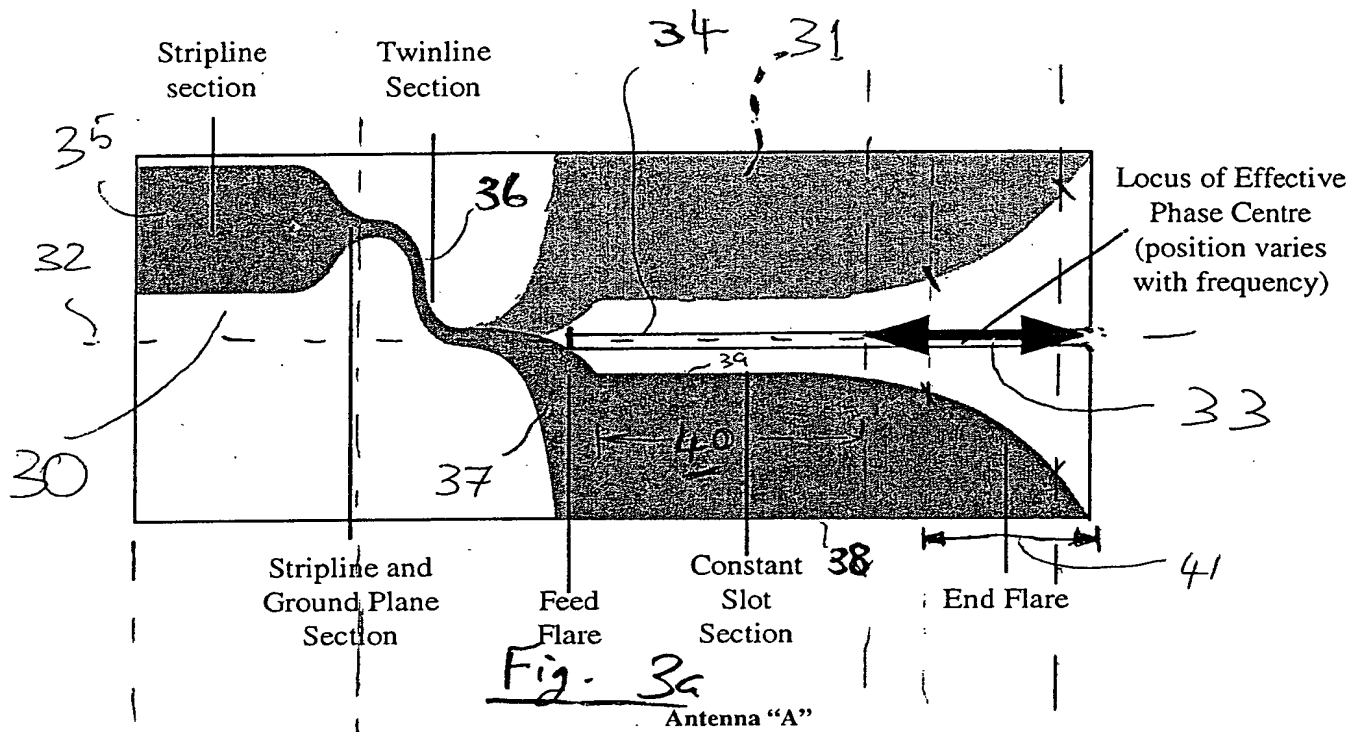
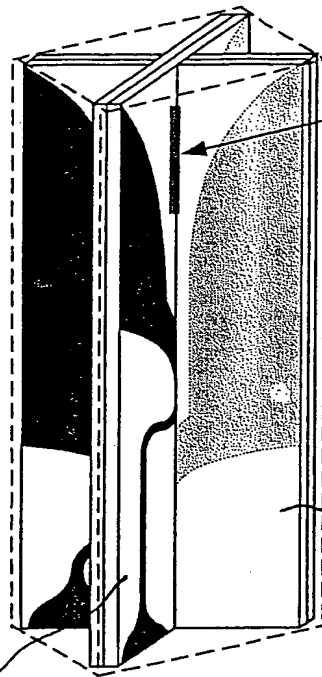


Fig 1.









Locus of Effective
Phase Centre
(position varies
with frequency)

47

48

Fig 4

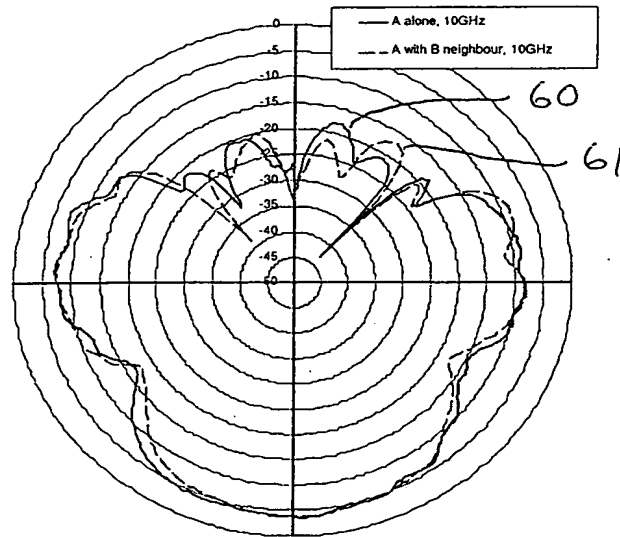


Figure 5a

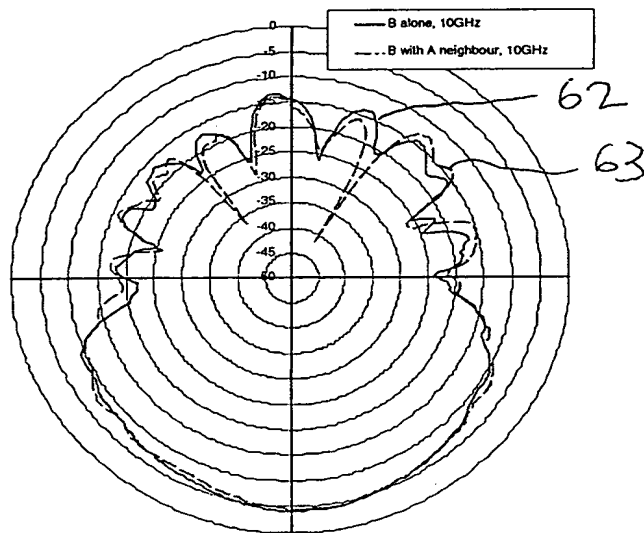


Figure 5b

